FINAL REPORT

on

GAS-PRESSURE BONDING OF BERYLLIUM GYRO AND STABILIZED PLATFORM COMPONENTS

to

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Marshall Space Flight Center

May 31, 1967

NAS 8-11964
Control No. 1-5-40-56325 S3 (1F)

by

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May 31, 1967

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Huntsville, Alabama 35812

Gentlemen:

Contract NAS 8-11964

Enclosed are the final reports on the subject contract. The report is entitled "Gas-Pressure Bonding of Beryllium Gyro and Stabilized Platform Components".

We have forwarded to you the following machined items:

1. One inner gimbal
2. Three sleeves
3. Three air-bearing sleeves
4. Three inner cylinders
5. Three inner cylinder covers.

These items complete the requirements under the referenced contract.

We hope the information contained in this report is sufficient for your needs. If there are any further questions, please contact us.

Very truly yours,

Hugh D. Hanes

Hugh D. Hanes
Associate Division Chief
Materials Development Division

HDH:gae

Distribution: PR-RC (1)
MS-IL (1)
MS-T (1)
MS-I (2)✓
R-ASTR-Z (1)
R-ASTR-G/Mandel (4)

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GAS-PRESSURE BONDING OF BERYLLIUM GYRO AND STABILIZED PLATFORM COMPONENTS

by

H. D. Hanes and P. J. Gripshover

SUMMARY

This study was conducted to prepare machining preforms of beryllium gyro and stabilized platform components by gas-pressure bonding and to prove feasibility by final machining components from these preforms. The components which were prepared for the ST-124 gyro were:

1. Stabilized platform gimbal
2. Sleeve
3. Air-bearing sleeve
4. Inner cylinder
5. Inner cylinder cover.

The approach for preforming these components had previously been developed in other NASA contracts.

Minor discrepancies occurred on some of the components but were judged satisfactory in most cases by the Technical Monitor. Only one of the twelve air-bearing components was lost because of an inclusion on critical surfaces which is well below the rejection rate normally experienced with conventional beryllium. The report contains the inspection reports from the machining vendors.

INTRODUCTION AND BACKGROUND

This is the final report on research performed on NASA Contract NAS 8-11964. The active contract period extended from January 1, 1966, until May 31, 1967 although the contract was initially approved in June, 1965. This program was funded by the National Aeronautics and Space Administration, George C. Marshall Space Flight Center. The Program Monitor was Mr. Richard H. Tuggle of the Astrionics Laboratory. The overall objective of the program was to fabricate and finish machine various gyro and stabilized platform components from the Saturn ST-124-M guidance system. The gas-pressure-bonding process was used to fabricate preforms from beryllium powder. Then, conventional machining processes used for beryllium gyro components were utilized to finish the parts to specified shapes. Development of the gas-pressure-bonding process for fabricating the machining preforms was performed under Contract NAS 8-11403 and NAS 8-11559. The results of these studies have been previously reported to NASA, and one of the contracts has been reported in the open literature in the report NASA-CR-58256.

This program was initially conceived to fabricate six experimental stabilized platform gimbals. However, as work proceeded, the project was modified to include some of the gyro and accelerometer components fabricated under previous studies. The following is a list of items which were to be gas-pressure bonded and machined to final configurations.

1. One beryllium ST-124-M inner gimbal.
2. Three beryllium inner cylinders.

3. Three beryllium inner cylinder covers.

4. Three gyro sleeves.

5. Three accelerometer sleeves.

In addition, nine machining blanks of Items 2 through 5 were to be supplied to NASA. These components were preformed from beryllium powder by the gas-pressure-bonding process. Following densification, they were machined to final configurations as specified by drawings supplied by NASA.

Gas-pressure bonding has been shown to be feasible as a means for compacting beryllium components into semi-finished shape. In this manner, machining costs and material losses are minimized so parts can potentially be made cheaper. Also, because of the higher pressure utilized in the pressing operation, the parts are pressed to near theoretical density. There is normally no residual porosity in these parts, thereby minimizing losses due to these causes. Finally, beryllium produced in this manner has been shown to have higher mechanical properties than conventionally hot-pressed block.

The process for preforming these parts had already been developed under the specified contract. Minor modifications were made in tooling to provide sufficient clean-up stock in some components because of minor machining problems previously experienced. However, the same tooling with these minor modifications was utilized to fabricate the preforms in this study. Therefore, virtually no development work was done in this program but rather proof of the process was shown by making the required components and machining them to final actual shapes. The objectives of the program have been met in full, and all of the components have been supplied to NASA.

This report will summarize all of the work done to produce the components listed above. In certain instances, slight deviations from the specifications were experienced, and these deviations are noted in the text of the report. Each individual component is discussed separately, and this discussion includes a brief resume of the fabrication process as outlined in previous reports. Appended to this report are dimensional certifications supplied by the two machining vendors, Barden-Leemath Corporation of Woodbury, Long Island, New York, and American Beryllium Company of Sarasota, Florida.

RESULTS

Inner Gimbal

Fabrication Method

The fabrication method for preforming the inner gimbals by gas-pressure bonding has been described in detail in the final report issued under Contract NAS 8-11559. This report, entitled "Fabrication of Beryllium Stabilized Platform Components by Gas-Pressure Bonding", was issued February 2, 1966. The beryllium powder was initially preformed by cold hydrostatic pressing in a shaped latex bag. The internal cavities in this component were formed by porous copper mandrels which could then be selectively leached from the beryllium in HNO_3 after densification. Porous mandrels were used to allow uniform densification during both cold and hot isostatic pressing.

Prior to loading, the hydropressing bag was vacuum formed into an accurately constructed loading jig. The porous mandrels were placed in positions which had been mathematically predetermined. The assembly was de-aired and pressed at 60,000 psi which yielded approximately 75 percent of theoretical density. The part was pressed in a sodium-chloride pressure-transmitting layer which allowed the complex geometry to be sealed into a cylindrical mild-steel container. The part was hot dynamically outgassed at 1000 F prior to compaction. Gas-pressure bonding for this and all the other parts was accomplished at 1400 F and 10,000 psi. After densification, the pressing container was stripped from the part and the sodium chloride removed by dissolving in water. The copper mandrels were leached from the beryllium block, leaving the cavities intact.

Preforming of Inner Gimbals on Current Studies

During this study, three inner gimbal blanks were gas-pressure bonded. Techniques described above and in the previous report were utilized in this study. No modification of the tooling and methods were required in this program. Figure 1 shows one of the machining blanks after gas-pressure bonding.

Of the three inner gimbal preforms pressed, only one was deemed satisfactory for finish machining. The second component showed cracking of the pressing around one of the cavities for mounting of the gyro sleeve. This cracking was attributed to a differential and thermal expansion between the copper mandrel and the beryllium preform. The beryllium in releasing

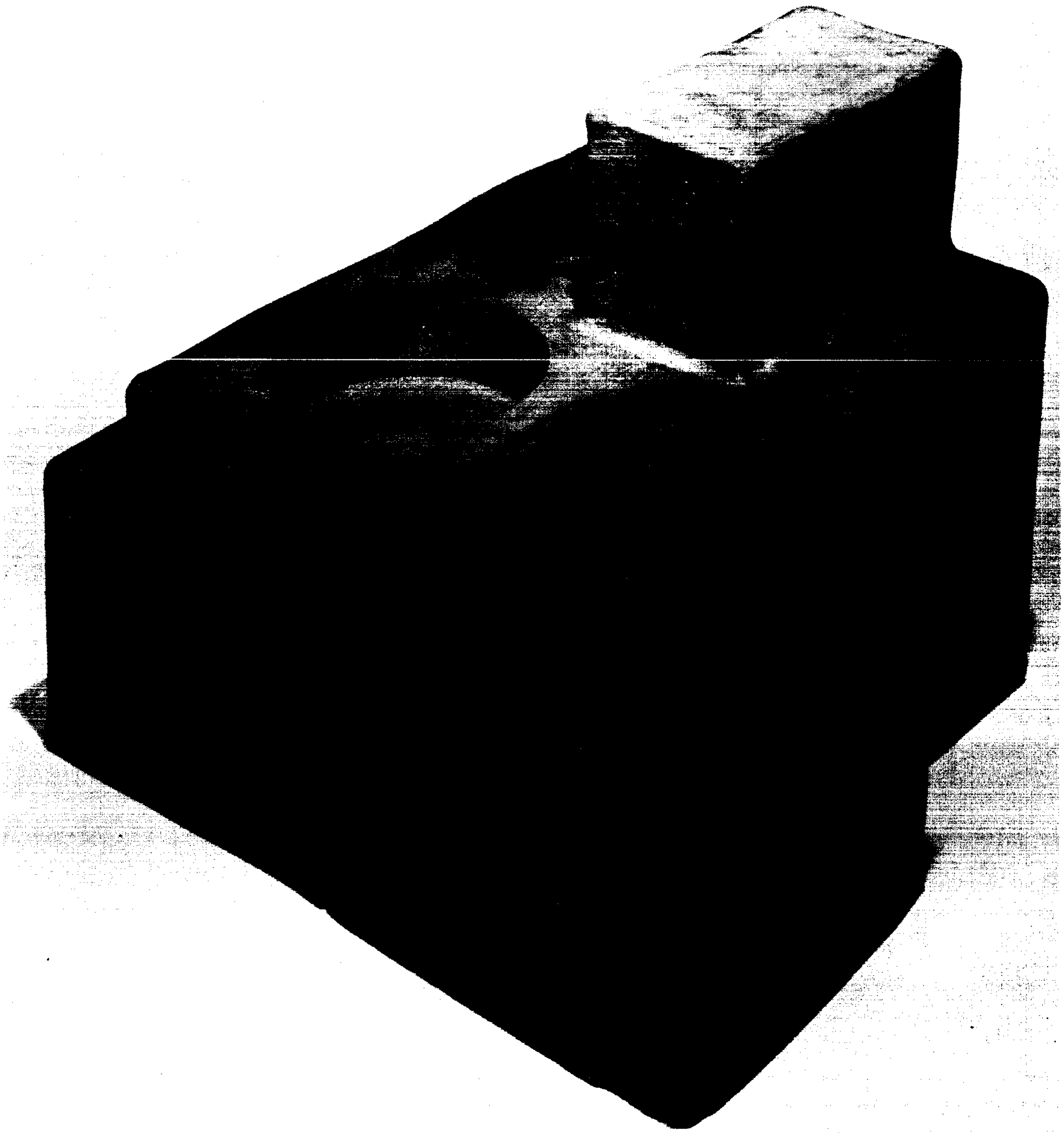

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FIGURE 1. MACHINING BLANK OF THE INNER GIMBAL

its bond from the copper mandrel apparently cracked. The third preform failed during the gas-pressure-bonding operation. A leak in one of the welds in the gas-pressure-bonding container caused the differential pressure to be negated during the bonding operation. This can was repaired and the entire assembly submitted to the operation a second time but a crack had appeared in the preform which would not allow it to completely densify in the area in question. At this time, it was deemed most expedient by the Technical Monitor to discontinue work on the inner gimbal preforms.

Machining of the Inner Gimbal

The one inner gimbal blank prepared in this study was successfully machined to finish specifications as shown in Figure 2. This illustrates the fully machined component produced from the gas-pressure-bonded blank. Although there were minor discrepancies which occurred in the machining of this component, it is felt that the resultant part will be usable.

The first problem experienced by the machining vendor was in the design of the gas-pressure-bonded blank itself. After the part was laid out for finish machining, it was noted there was insufficient stock for clean-up in one surface adjacent to the trunnion mount. The lack of material was inadvertently designed in the machining blank itself and was not a result of the fabrication operation. However, since it was on a non-critical surface, the Technical Monitor deemed that the component would be acceptable with this monor deficiency in it.

When machining was initiated on this component by the Barden-Leemath Corporation, it was felt that there was a tendency for excessive

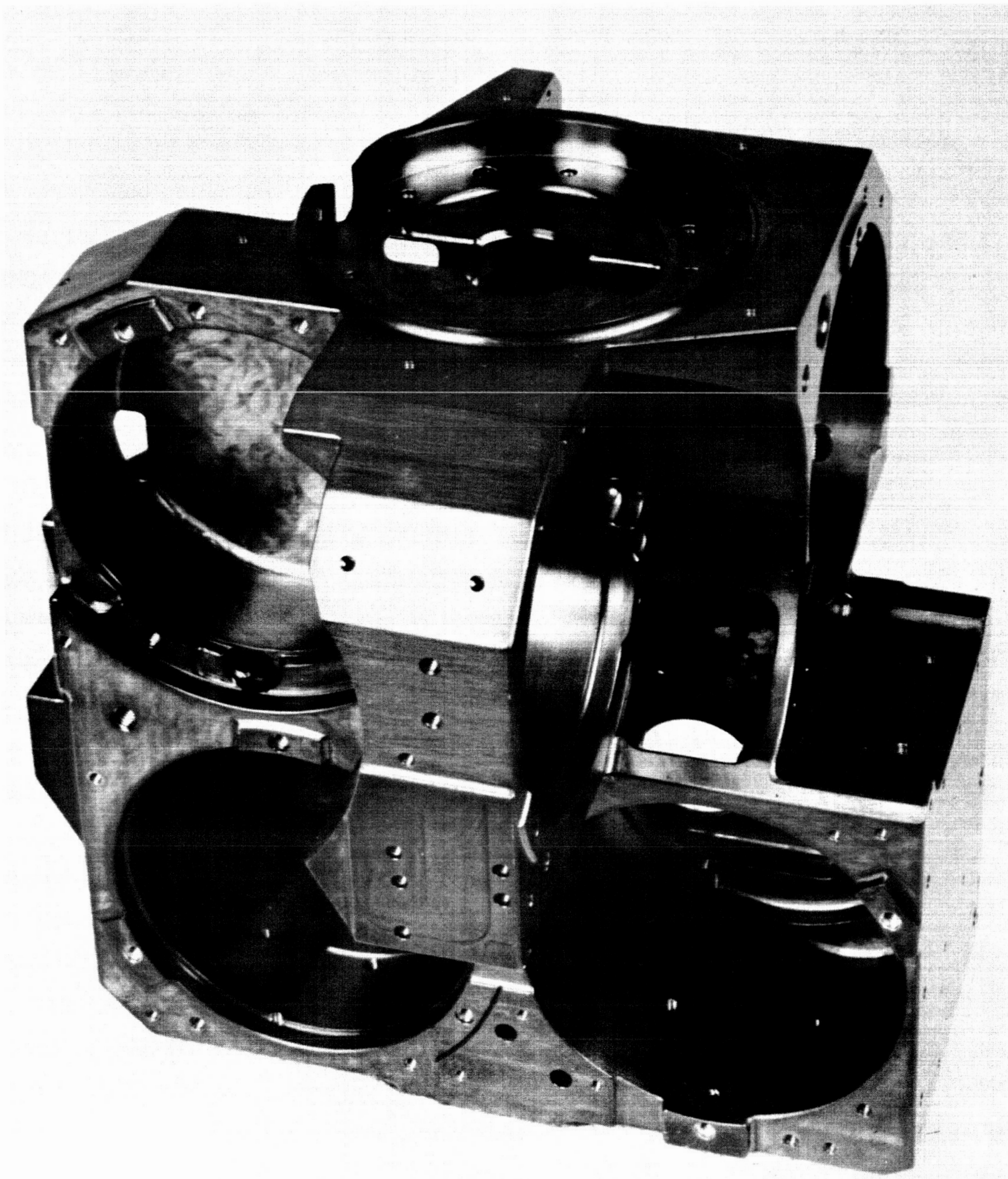

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FIGURE 2. INNER GIMBAL AFTER FINAL MACHINING

chipping on the exit areas of the machining surface. This was, however, only noted during the initial cut on the part. When the as-pressed surface was removed from the part, machining appeared to proceed at a normal rate. In reviewing the fabrication process, it was noted that a copper foil vapor barrier was placed around the beryllium preform prior to pressing into the sodium chloride pressure transmitter. It is felt that reaction caused by diffusion of the copper into the beryllium preform resulted in a solid-solution strengthening of the beryllium. This also embrittled the beryllium, making machining of the outer surface more difficult. However, once the diffusion layer was removed from the component, machining proceeded at the normal rate. In future fabrication runs, if a copper vapor barrier were to be used, it would seem advisable to chemically mill the component before machining, thereby removing the difficult-to-machine skin from the beryllium blank.

A third problem was noted with this component during annealing after the rough-machining operation. The specification requires that the part be stress relieved at 1450 F prior to the final machining cut. After the stress-relieving operation, it was noted that dimensions of the rough-machined beryllium blank had slightly changed. Concurrent studies at Battelle on another program had indicated there was a slight loss-in-density problem after heating to relatively high temperatures following the gas-pressure-bonding operation. This has been attributed to lack of complete outgassing of gas-pressure-bonded beryllium prior to the pressing operation. Included gases in the microstructure resulted in a slight loss in density and subsequent swelling. This loss in density in gas-pressure-bonded beryllium is normally less than 1/2 percent at 1450 F. There normally is no change in mechanical properties accompanying this.

After the change in dimensions was noted, the part was given a second stress-relieving treatment at the same temperature, and this time there was no growth noted in the machining blank. Since none of the machining of the critical dimensions had yet occurred, it was possible to save the part and proceed with the final machining operation. There are no dimensional discrepancies on this component in the critical-surface areas. Dimensional certification of the part is contained in Appendix A of this report.

Gyro Sleeve Fabrication

Basic Fabrication Approach

The gyro sleeve is first preformed by drawing a rubber bag into a vacuum form of proper configuration. Then, the beryllium powder is vibratory packed into position around a leachable copper mandrel. The entire composite is then hydrostatically pressed to form the beryllium powder in a single-piece shape approximating the final machined component. The protrusions on the external surface of this component are pressed inwardly to the part. Following green preforming, the component is pressed into a sodium chloride pressure-transmission layer which will allow final compaction of the component in a simple cylindrical bonding container.

After canning the components, the entire composite is hot dynamically outgassed. Then, the evacuation stem is sealed closed and the part gas-pressure bonded at 1400 F. Removal of this component from the bonding container is similar to that of the inner gimbal. The sodium chloride pressure-transmission layer is dissolved in water, and the copper mandrel which defines the bore of the component is dissolved in nitric acid.

Fabrication of Gyro Sleeve Preforms

Following the procedure outlined above, twelve preforms of the gyro sleeve were fabricated. No problems were experienced in the production of these particular components. After gas-pressure bonding, all of the parts were dimensionally analyzed, and three of the components were forwarded to the machining vendor. The other nine were shipped to Marshall Space Flight Center for their evaluation.

Dimensional evaluation revealed that the exterior surface of the components was close to the required finished dimension. Therefore, the three largest components were selected for finish machining by the vendor to allow sufficient room for setup. Of the nine components supplied to NASA, clean-up might be difficult on the exterior surface. Density measurements on the fabricated components indicated that essentially all of the parts were of full theoretical density. It should be noted that no dimensional changes were noted on the parts machined by the vendor after stress relieving. Also, no machining difficulties were experienced in this material. Figure 3 demonstrates a typical gyro sleeve machining blank produced by gas-pressure bonding.

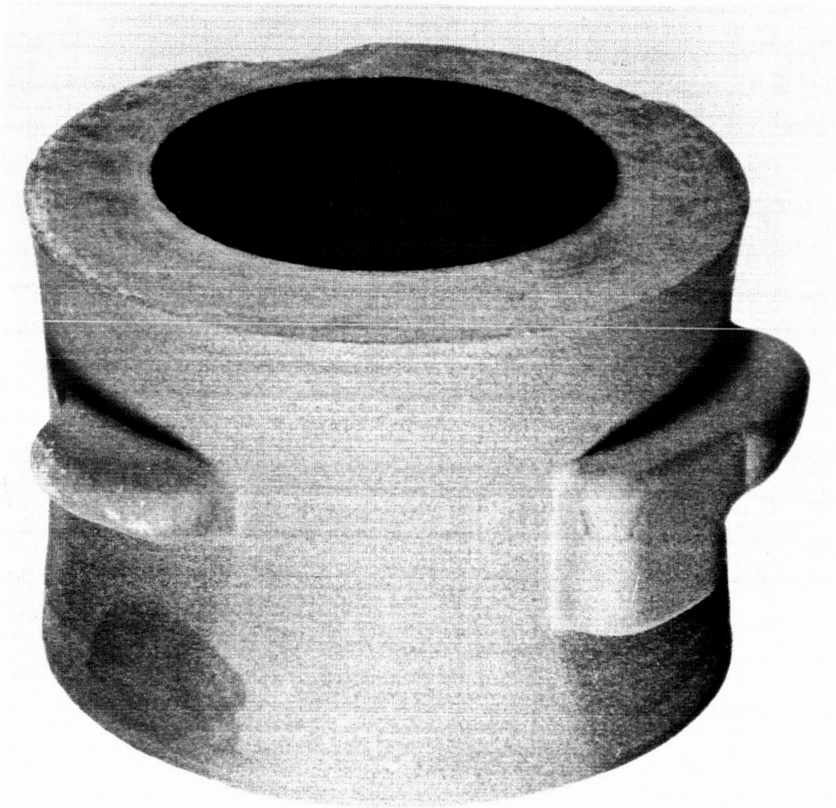

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FIGURE 3. GAS-PRESSURE-BONDED GYRO-SLEEVE MACHINING BLANK

Machining of Gyro Sleeves

Finish machining of the gyro sleeves was accomplished by the American Beryllium Company of Sarasota, Florida. Figure 4 shows one of the gyro sleeves after final machining. Of the three gyro components which were finish machined, only one of them had dimensional discrepancies. The counter sink area for the air holes on the external surface of this cylinder was machined too deeply in one case. However, it was deemed by the Technical Monitor that this would not affect the operation of the component so it was deemed acceptable.

The third component originally forwarded to the machining vendor was rough machined to the point where the internal bore of the part was to be lapped. At this time, it was noted there were spots of apparent porosity on the surface of the component. Xygloing the part at the vendor's site confirmed the presence of porosity in this particular spot. The component was again viewed at Battelle, and it was deemed unaccessible. Therefore, a replacement blank was forwarded to the machining vendor. It should be noted that during the fabrication of all the components in this program this was the only specimen that was rejected because of porosity on a critical surface.

Prior to shipment of the make-up component to the machining vendor, rough machining was done at Battelle to ascertain that sufficient material would be available for finish machining the external cylindrical surface. As was previously noted, there was very little clean-up left on the external surface of the gyro sleeve preforms. Since it was doubtful

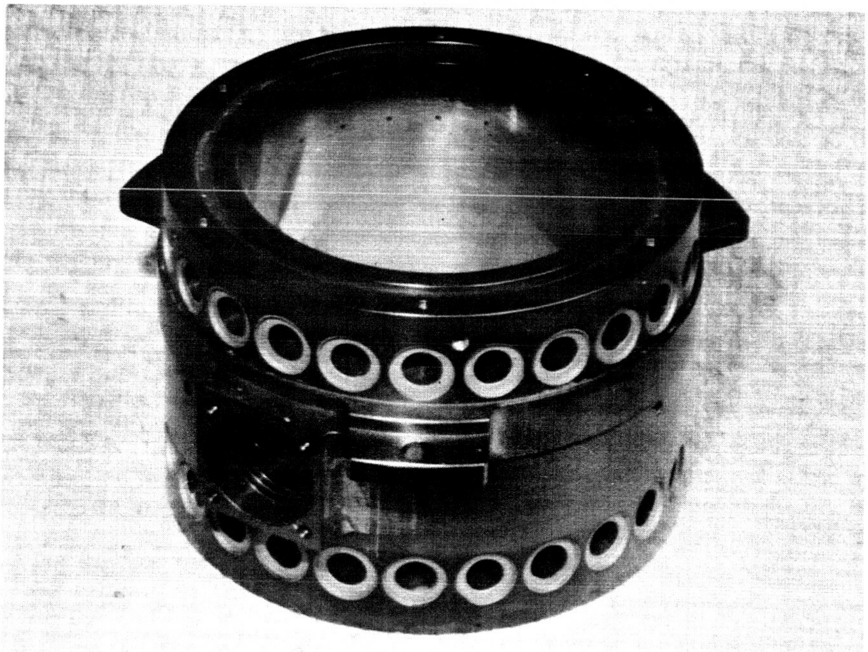

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FIGURE 4. GYRO SLEEVE AFTER FINISH MACHINING

that this part could be cleaned up on the external surface, it was deemed expedient to finish this component by hand. The critical surfaces could be machined, and this would not interfere with the operation of the component. Therefore, to provide a complete set of gyro sleeves for testing at NASA, the third component was accepted with insufficient clean-up on the external cylindrical surface.

Certification of the dimensions of these components are contained in Appendix B, and it can be noted that there are no deviations except those noted in the text of the report.

Accelerometer Sleeves

Description of Fabrication Process

The basic approach utilized to fabricate these components was that of bonding green-pressed pellets onto the surface of the green-pressed right circular cylinder during densification. The main body of the accelerometer sleeve was pressed from beryllium powder around a leachable copper mandrel. Then, the pellets to form the trunnions were pressed in a separate operation. The bonding container was fabricated in such a manner as to include space for the extensions on the external surface of the cylinder.

Hot dynamic outgassing and gas-pressure bonding were done at the same conditions previously noted. After densification, the mild-steel bonding containers were removed by pickling in nitric acid. Copper mandrels were also removed in this manner. In the past, insufficient stock was provided on the exterior surface of the component to allow clean-up at the base of the trunnions. However, compensations were made in existing tooling to allow sufficient stock for final clean-up in the parts in this study.

Preforming of Machining Blanks

Twelve machining blanks of the accelerometer sleeve were fabricated in the manner listed above. Of the components densified, there were no problems experienced with either lack of densification or cracking of the preforms. Measurements indicated there would be sufficient stock for machining the required specimens from the blanks densified. Immersion density measurements revealed complete densification of these components.

Of the twelve specimens densified, nine were shipped to NASA in the as-pressed condition for their evaluation. The other three were shipped to the American Beryllium Company for machining to final configuration. Figure 5 shows a gas-pressure-bonded preform of the accelerometer sleeve.

Machining of the Accelerometer Sleeves

During machining of these components, there were no materials defects noted on any of the critical surfaces. Sufficient stock was present to allow complete finishing of the accelerometer sleeves. There were no dimensional discrepancies in the finished parts as noted in Appendix C. Figure 6 shows an example of the accelerometer sleeve after finish machining.

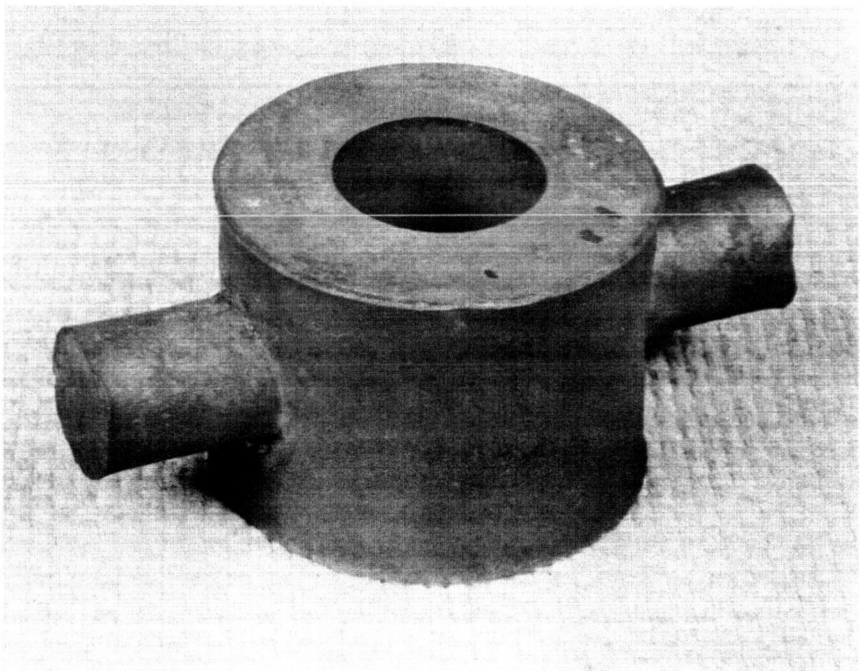

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FIGURE 5. AS-PRESSED BLANK OF THE ACCELEROMETER SLEEVE

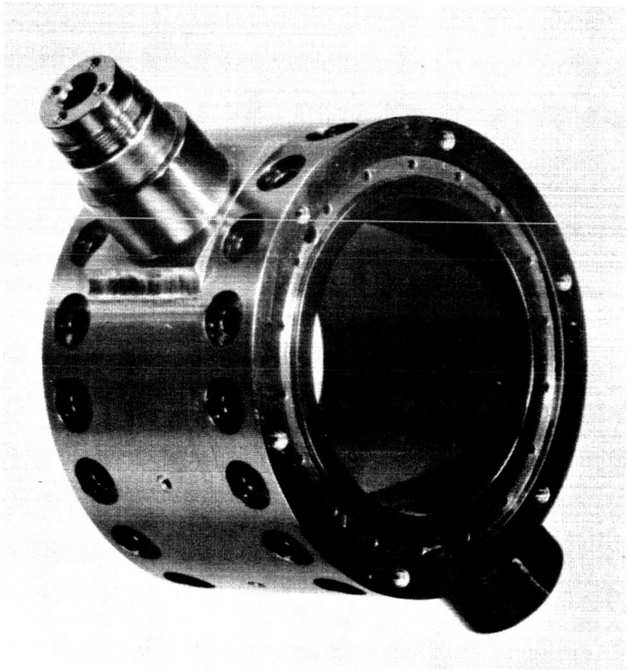

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FIGURE 6. MACHINED ACCELEROMETER SLEEVE

One procedural discrepancy was experienced during machining of this component. One of the mounting trunnions at the sleeve has a 1-mil increase in diameter near the body of the sleeve itself. Inadvertently, during the finishing operation, the machinist neglected to allow sufficient stock for this step. To bring the part back into specification, American Beryllium had an electroless nickel plating applied to the surface of the trunnions on Specimens 2 and 3. After performing this operation, the part was finished within the specified dimensions. All three of these finished components have been forwarded to NASA for their evaluation.

Fabrication of Inner Cylinders

Discussion of Approach

The inner cylinders were fabricated from pieced components which were preformed from beryllium powder. The main body of the inner cylinder was pressed onto a copper mandrel. The extension at the top was preformed as a separate button. This part was canned in a container which conformed to the external surface of the component. An extension was provided in the upper end of the container for the small protrusion on the component.

These components were again processed by the same parameters already reported. After densification, the mild-steel cans and the copper mandrels were removed by leaching in nitric acid. Since parts had successfully been prepared from existing tooling in the past, there was no need to modify the tooling for the work done on the current job.

Fabrication of Inner Cylinder Preforms

As previously noted, the loading fixtures were the same configuration as had been previously utilized. However, the internal cavity configuration was changed from the double taper originally pressed to a hemispherical end in the new design. This required altering of the mandrels but did not change the cross section of the loading fixture.

All of the twelve components required for this task of the study were successfully pressed. No problems were experienced with the random cracking as noted in some of the previous specimens. Measurements indicated there was sufficient stock on all of the specimens pressed to machine the specimens to configuration. Density, which was checked by immersion techniques, was found to be 1.865 (essentially full theoretical) in all of the components. Three parts were randomly selected for final machining, and the other nine were forwarded to NASA for their evaluation. Figure 7 shows one of the machining blanks of the inner cylinder produced by gas-pressure bonding.

Final Machining of Inner Cylinders

Certification sheets of the final machined dimensions of the inner cylinders are listed in Appendix D. Machining of these components was accomplished by American Beryllium Company, and there were no problems encountered during the performance of the operation. The finished components were shipped to NASA for final evaluation.

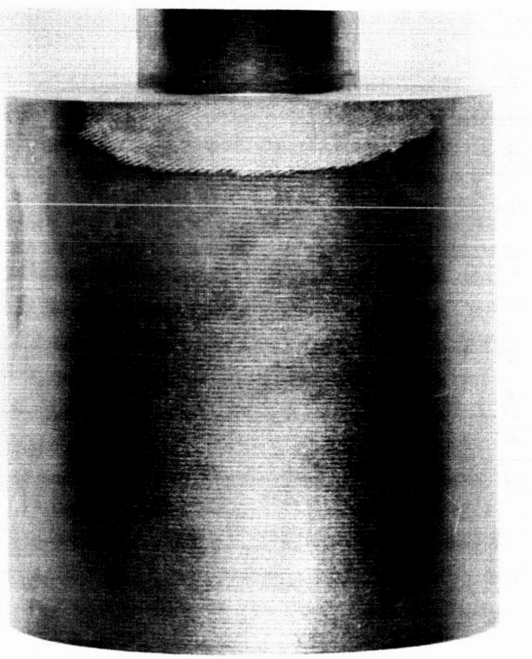

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FIGURE 7. GAS-PRESSURE-BONDED INNER CYLINDER

Inner Cylinder Covers

Fabrication Approach

The basic gas-pressure-bonding approach utilized for these components is identical to that utilized for the inner cylinders themselves. The only difference is that the body of the cover is somewhat shorter, and more stock has to be allowed in the region of the legs which support the gyro. Previously, there had been very few problems associated with fabricating these components. Slight problems had been experienced with allowing sufficient stock over the region of the arms to allow complete clean-up of the finished specimen.

Fabrication of the Machining Blanks

One change was noted in the overall dimensions of this component as compared to those previously fabricated. The bottom of the cover was altered to include a spherical radius rather than the tapers previously experienced. Because of this, slight modification of the pressing tooling was necessary. Also, the diameter of the body was increased slightly to allow sufficient clean-up stock on the external cylindrical surface. With these minor modifications, there were no problems experienced in fabricating these components.

After outgassing at 1000 F prior to final closure of the pressing container, the specimens were gas-pressure bonded at 1400 F as was the case for the other parts in this study. The can and mandrel were removed by leaching in nitric acid. Evaluation of the components revealed sufficient stock for machining the desired shape from these preforms. Immersion density checks revealed full densification in all cases. Figure 8 demonstrates one of the as-pressed machining blanks. These parts were finish machined by Barden-Leemath Corporation.

Machining of Inner Cylinder Covers

Dimensional discrepancies were noted on Parts 1 and 2 of the inner cylinder covers. These discrepancies were discussed with the Project Monitor and, with the exception of the thickness of the gyro mounting arms, were all accepted. It was necessary to alter the width and thickness of the gyro support arms on both pieces to be within .0005 in. of each other on each side. This was done to conform with the minimum dimension noted in the letter reproduced in Appendix E.

One comment from the machining vendor is worthy of note in this section of the study. Because of the hemispherical cross section required in the bottom of this component, it was necessary to generate this surface by electron-discharge machining. Otherwise, it would be necessary to generate the surface on a three-axis milling machine. The machinist noted that the pilot hole in this case was not beneficial to the machining operation because he could not keep an even pressure in the coolant until his tool was well inserted into the pilot hole. Therefore, it took him more time to machine the cavity by this method than it would have in a solid piece of block. Therefore, the value of preforming the part in this manner is somewhat questionable.

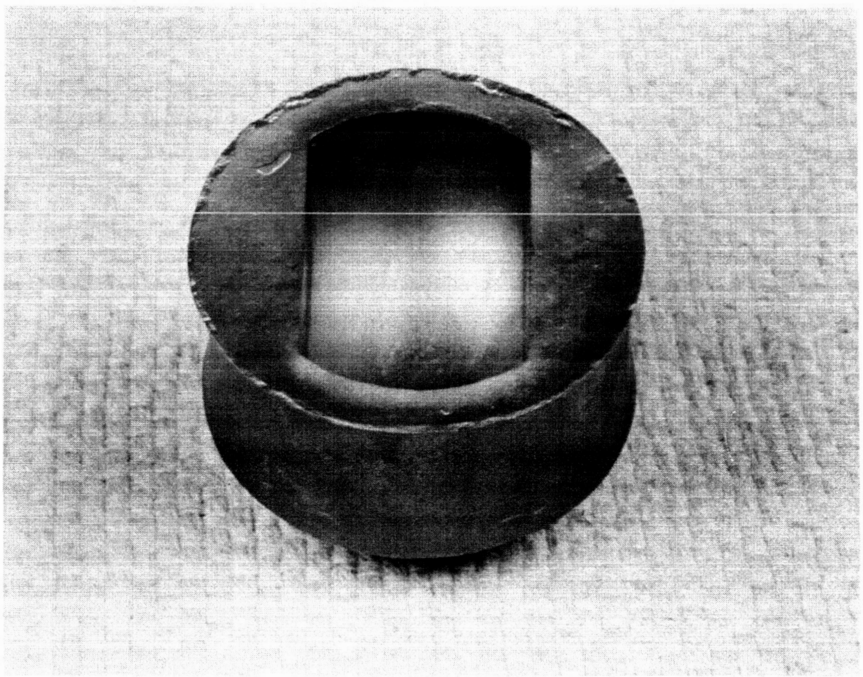

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FIGURE 8. AS-PRESSED INNER CYLINDER COVER BLANK

Figure 9 shows one of the final machined inner cylinder covers. Except for the discrepancies previously noted, there were no further problems encountered with these components. They have been forwarded to NASA for the utilization and evaluation.

CONCLUSIONS

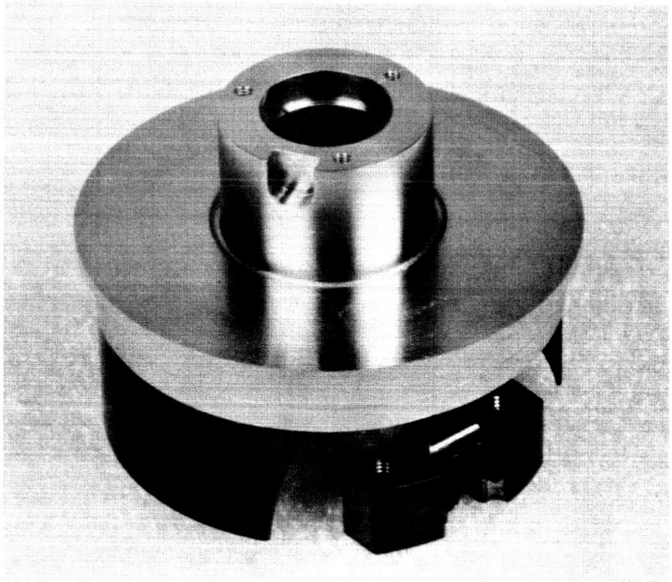
On the basis of the results previously discussed, the following conclusions can be reached in this study.

1. The gas-pressure-bonding technique was shown to be a feasible method for fabricating all of the parts in this study as evidenced by the completion of all of the components required.

2. Higher-quality material with less defects due to inclusions or porosity is produced by gas-pressure bonding as evidenced by the fact that only one out of twelve finish machined parts was rejected because of material defects.

3. A near-finished-dimension inner cylinder cover blank is not practical to fabricate by gas-pressure bonding for the reasons already given in the text.

4. The initial machining characteristics of the inner gimbals were worse than expected because of the diffusion of the copper barrier vapor into the surface. However, no problems were experienced after the surface skin was removed, and the machinability of the other components was as good or better than conventional hot-pressed block.



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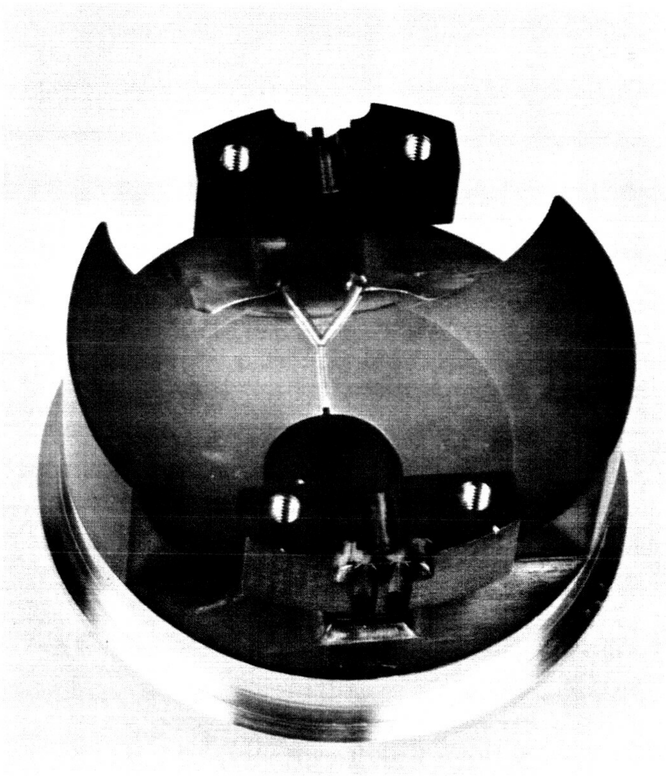
a. Top View



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b. Bottom View

FIGURE 9. FINISH-MACHINED INNER CYLINDER COVER

5. Because of the swelling experienced in the largest part, increased outgassing capacity will be necessary to prevent swelling of inner gimbals in future bonding operations.

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APPENDIX A

DIMENSIONAL CERTIFICATION OF INNER GIMBAL

APPENDIX B

DIMENSIONAL CERTIFICATION OF GYRO SLEEVES

AMERICAN BERYLLIUM COMPANY, INC.

MANUFACTURERS OF ULTRA PRECISION MACHINED PARTS

P. O. BOX 1479 • U. S. HIGHWAY 301 AT TALLEVAST ROAD • SARASOTA, FLORIDA 33578

To: BATTELLE MEMORIAL INST.
505 KING AVE.
COLUMBUS, OHIO

Date 3-29-67

Purchase Order No S 6370

Part No X 1837870/R

Packing Slip No 31971

Quantity 1

Cert. A [XX] We certify that, to the best of our knowledge, the articles conform to your drawing and purchase order requirements.

Cert. B [ ] We certify that materials used on this order meet specification requirements and that the physical and/or chemical test reports are on file subject to examination.

Cert. C [XX] We certify that materials used were only those supplied by BATTELLE MEMORIAL INST. specifically for this order.

Cert. D [ ] We certify that the above described parts have been processed in conformance to the required specifications as listed below.

Gov't. MIL or your Spec. No.	Name and Address of Processing Firm	Gov't. Cert. Approval No.	Approval Date

AMERICAN BERYLLIUM COMPANY, INC.

C. B. Lehman for F. W. Schrader

F. W. Schrader, Quality Control Mgr.

B/P SHEET 1
PAGE 1

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2.703	2.707	36	3.172	3.1725	71	2.312	2.314
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1/16R	1/16	47	1.703	1.7075	82	1/2 R TYP	1/2
11K .002	.002	48	1.953	1.957	83	5/32 R TYP	5/32
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.047	.049		11K .002	.002	89	1.688±.003	1.6935
21°	21°		4.390	4.3945	90	.718	.718
.500	.499		11K .002	.001		2.000±.003	2.006 [illegible] 2.002 [illegible]
.844	.849	57	1.125 DIA. THRU	1.126		5/8	.635
1.250	1.258	58	.344	.344		3.000 DEEP	3.000
11L .002	.001	59	60°	60°		.187+.005 DIA	.1875
2.578	2.575	60	1 11/16	1 11/16		1.000	1.0045
3.781	3.7765	61	1 1/8	1 1/8		7/8	.885
5.188	5.192	62	3/4	3/4		5/16	.302
3.250 #2 End 3.262	3.255 (284 End)		.688	.678	98	3.406	3.405
1.718R	1.718 R		.219	.224	99	1.844	1.842
⊥JK .002	.002		1/16 R ALL AROUND	1/16	100	30°	30°
.047	.047	66	5/32	.158	101		
1.500	1.504		.366	.366	102		
1.766	1.775		.375R	.375	103		
30°	30°	69	3/8	.365	104		
.047	.042	70	.500	.4895	105		

INSP BY [signature] DATE

CERTIFICATE OF COMPLIANCE

BARDEN-LEEMATH
DIVISION OF THE BARDEN CORPORATION
45 CROSSWAYS PARK DRIVE • WOODBURY, L. I., NEW YORK 11797 • TWX-510-221-2185 • TEL. 516-921-3080

To: BATTELLE MEMORIAL INSTITUTE
505 KING AVE
COLUMBUS, OHIO

Gentlemen:

We hereby certify that the material and/or work performed in the quantities as called for in Purchase Order No. S6371

Part Nos. 1839081 Date Shipped 4/27/67

Packing Slip No. 1068 are in conformance with the requirements, specifications and drawings listed on the order.

Test reports for this material are on file and are available on request.

Harry Prince
QUALITY CONTROL MANAGER

DATE

[illegible] CORP — RECORD OF ACTUALS — B/P SHEET 1, PAGE 2

PART NO. 1839081 REV. S S/N ______ P.O. NO. ______

B/P NO.	B/P DIM	ACTUAL	B/P NO.	B/P DIM	ACTUAL	B/P NO.	B/P DIM	ACTUAL
101	1/8 x 45°	1/8 x 45°	136	1/8	1.131	171	1.562	1.566
102	1/4" R	1/4	137	60°	60°	172	1/2	.500
103	30°	30°	138	3/16 R TYP	3/16 R.	173	1/4	.253
104	.594	.591	139	.516	.516	174	1/8	.1235
105	1/4 R TYP	1/4 R.	140	1/2" x 45°	1/2 x 45°	175	1/32	.026
106	1 5/8 R	1.631 R.	141	2 1/2 R	2.505	176	1/16	.061
107	13/16 DIA	13/16 DIA ±.011	142	3.312	3.322	177	.125	.123
108	3/8-24 UNF 3B	OK	143	4.125 DIA.	4.129	178	1 1/8	1 1/8
109	5/8 DEEP	5/8	144	1.718	1.721	179	3 1/2 DIA.	3 1/2
110	32 ✓	32 ✓	145	.312	.3125	180	4.000	3.9980
111	1.950 R	1.955	146	.375	.3775	181	3.515	3.5235
112	1.960 R	1.964	147	1.781	1.7825	182	1.281	1.282
113	3.719	3.720	148	1.062	1.061	183	.844	.847
114	2.000	2.013	149	10° ± 15'	10°	184	1/2 R TYP	1/2
115	1/2	.500	150	1/4 R TYP	1/4 R	185	3.375 R	3.380
116	9°	19°	151	.469	.470	186	3/8 DIA. AS SHOWN	3/8
117	19°	19°	152	1/2 R	1/2	187	30°	30°
118	11°	11°	153	3/16	.185	188	45°	45°
119	49°	49°	154	45°	45°	189	45°	45°
120	3/8	3/8	155	1/2 R	1/2	190	.844	.849
121	3/4	3/4	156	.281	.267	191	2 13/16	2.851
122	1.960 R	1.964	157	1.250	1.249	192	1/4	1/4
123	1.937 R	1.942	158	.438	.442	193	2 7/16	2.438
124	1.960 R	1.964	159	⊥ J .002	.002	194	3.250	3.250
125	1.950 R	1.955	160	1.203-005	1.200	195	1/16 R ALL AROUND BOTH SIDES	1/16"
126	2 7/16	2.452 (HIGH LIMIT)	161	1.312	1.309	196	1/8 R.	1/8
127	2.000 ± 003	2.011	162	.047	.048	197	1/2 R TYP	1/2
128	1.800 ± 001	1.8075 (2)	163	1.031 ± 002	1.031 (2)	198	1/8 R	1/8
129	1 1/8	1.131	164	1.375 ± 002	1.377	199	.156	.1605
130	1/8 APP. R.	5/64	165	30°	30°	200	1/16	.0655
131	1/8	.120	166	1/4	1/4	—		
132	2.000	2.002	167	.419	.421	—		
133	1"	1.008	168	2"	2.025	—		
134	1/2"	.502	169	5/16	5/16	—		
135	1/4"	.251	170	3/8	.380	—		

INSP BY [signature] DATE ______

RECORD OF ACTUALS

B/P SHEET 1
PAGE 3

PART NO. 1839081 REV. S B/P NO.

B/P DIM	ACTUAL	B/P NO.	B/P DIM	ACTUAL	B/P NO.	B/P DIM	ACTUAL
15°	15°	236	1.000	1.003	71		
30°	30°	237	1.187 ±003	1.1895 (584 dia) 1.193 (#7 pcrc)	72	1"	1"
.812	.813	238	3/4 TYP	3/4	73		
.250	.249	239	45°	45°	74		
2.469	2.4685	240	1"	.985	75		
1 11/16	1 11/16	241	45°	45°	76		
2 5/16 DIA	2.321	242	30°	30°	77		
1.937 R	1.942	243	45°	45°	78		
1 11/16	1 11/16	244	3/8 TYP	3/8	79		
1"	1"	245	1 7/16	1 7/16	80		
.281	.2795	246	2.500 ±003	2.509	81		
.125	.1265	247	1/16 R ALL AROUND	1/16	82		
1.812	1.815 (284 dia) 1.822 (#7 crc)	248	1/2	1/2	83		
2.000	2.011	249	48°	48°	84		
1.960 R	1.965	250	12°	12°	85		
1.950 R	1.955	251	7/8	.850	86		
1.960 R	1.964	252	.390	.395	87		
4.000	3.998	253	3/4 TYP	3/4	88		
3.406	3.4035	254	3/8 TYP	3/8	89		
1/4 R TYP	1/4	255	1/4	1/4	90		
.187 +005 DIA.	.188	256	45°	45°	91		
5.187 DEEP	5.192	257	.875 R TYP	.877	92		
1/4" R TYP	1/4	258	NOTE 2		93		
1 1/8	1.233	259	3		94		
1/2	1/2	260	5	✓	95		
45°	45°	261	6	✓	96		
1.031 ±002	1.023	262	7	✓	97		
3/8	3/8	263	8	N.A	98		
.047 +005	.0475	264	9	N.A	99		
1.125 DIA THRU	1.128	265	10	N.A	100		
1.937 R TYP	1.941	266	11	N.A	101		
1 1/8	1.129	267	12	N.A	102		
1 5/8 R	1.628	268	14		103		
.875 R TYP	.877	269			104		
1/4 x 45°	1/4 x 45°	270	1 9/16	1.569	105		

DONE BY [illegible] DATE

[illegible] CORP

RECORD OF ACTUALS

B/P SHEET 2
PAGE 1

PT NO. 1839081 REV. 5

B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL
120° INCL.	120°	36	.791±003	.7892	71	.750	.7523
.500+.015 DIA.	.500	37	2.299±003	2.300	72	1.000	.9992
32✓	O.K.	38			73	4-48 UNF 3B	O.K.
.390+.005	.393	39	3.187	3.1875	74	3/8 DEEP	3/8"
45°±5°	45°	40	2.050	2.050	75	.921	.922
.063+015	.067	41	.344	.3417	76	.312	.3115
.025+015	.032	42	2.937	2.932	77	.125	.125
.020 MAX R	.015	43	2.050	2.045	78	.250	.2495
6-40 UNF 3B	O.K.	44	1.000	1.0015	79	4-48 UNF 3B	O.K.
3/8 DEEP	3/8"	45	.500	.4995	80	3/8 DEEP	3/8"
.147 $^{+.005}_{-.001}$ C'BORE	.147	46	.688	.684	81	.375	.375
.047 DEEP	.049	47	3/8	.379	82	.844±003	.8462
⊕G.003 DIA.	.003	48	.437	.4362	83	.812±003	.815
2.875 DIA. BSC	2.875	49	.500	.5017	84	.187	.1875
4-48 UNF 3B	O.K.	50	1.312	1.310	85	5/8	5/8
6-40 UNF 3B	O.K.	51	.062	.062	86	.312	.3135
3/8 DEEP	3/8"	52	1.438	1.4365	87	3.578	3.577
2.136±003	2.1362	53	2.000	1.9995	88	.219	.2195
2.173±003	2.1757	54	1.060	1.059	89	.656	.656
.242±003	.245	55	1.375	1.375	90	1/4	.248
3/8	.372	56	5/32	5/32	91	.875	.875
.885±003	.888	57	.281	.298	92	.109	.111
2.173±003	2.1742	58	.375	.389	93	3/16	3/16
1.797±003	1.7962	59	.562	.575	94	8-36 UNF 3B	O.K.
.500	.4982	60	.750	.763	95	3/8 DEEP	3/8"
.375	.375	61	1/8	.1245	96	.172 $^{+.005}_{-.001}$	.174
1.455±003	1.4556	62	.687	.6857	97	.047 DEEP	.046
2.875 DIA.	2.876	63	1.625	1.625	98	3.560 DIA BSC	3.560
.219 $^{+.005}_{-.001}$ DIA	.220	64	2.000	1.9982	99	4-48 UNF 3B	O.K.
1/16 DEEP	.054	65	.800	.7997	100	3/8 DEEP	3/8"
.791±003	.7940	66	6-40 UNF 3B	O.K.	OA	⊕U .003 DIA.	.003
1 3/4	1 3/4	67	3/8 DEEP	3/8"	=		
2 1/2	2 1/2	68	.738	.7355	=		
4-48 UNF 3B	O.K.	69	.662	.660	=		
3/8 DEEP	3/8"	70	.400	.4015	=		

INSP BY G.B. (Gordie) DATE 4/26/67

LORAIN CORP. RECORD OF ACTUALS B/P SHEET 2

PAGE 2

PART NO. 1839081 REV. S SH. ______ P.O. NO. ______

B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL
1/4-28 UNF 2B	1/4-28		.281	.2807		5/8	5/8
.438 DEEP	.440		.500 ±003	.503		.406	.405
2.937	2.936		4-48 UNF 3B	O.K.		1/2	1/2
.094	.094		3/8 DEEP	3/8"		.688 ±003	.687
.281	.2795		.120 $\pm^{004}_{001}$	.120		2.500	2.5002
1.000	.999		.047 DEEP	.047		10°	10°
.437	.440		3/8-24 UNF 3B	O.K.		20°	20°
8-36 UNF 3B	O.K.		5/8 DEEP	5/8"		2.000	1.996
3/8 [illegible]	3/8"		6-40 UNF 3B	O.K.		2.379 ±003	2.3807
.172 [illegible]	.172		3/8 DEEP	3/8"		1/4-28 UNF 3B	O.K.
3.5[illegible] BSC	3.560		.147 $\pm^{005}_{001}$	.148		.438 DEEP	.440
2.625	2.6215		.047 DEEP	.047		4-48 UNF 3B	O.K.
6-40 UNF 3B	O.K.		3.250 DIA BSC.	3.250		.188 DEEP	.190
3/8 DEEP	3/8"		5/8	5/8		DO NOT BREAK THRU	O.K.
2.000	2.0017		5/8	5/8		.625	.6225
3.125	3.1232		2.602 ±003	2.6042		1.109 ±003	1.1072
1"	1.002		2.011 ±003	2.0132		.343 ±003	.346
.312	.3115		2.585 ±003	2.5862		1.687 ±003	1.690
3.437	3.433		2.467 ±003	2.4677		.937	.9377
3.062	3.064		2.011 ±003	2.009		1.125	1.1245
.625	.6245		3.469	3.469		.219 $\pm^{005}_{001}$ DIA	.218
.500	.499		6-40 UNF 3B	OK		1/16 DEEP	.063
7/16	7/16		.147 $\pm^{005}_{001}$	.148		3.250 DIA.	3.250
3.500	3.500		.047 DEEP	.047		1.000	1.000
.156	.1552		5/16	5/16		.500	.500
.250	.2492		.456 ±003	.457		.437 ±003	.4387
8-36 UNF 3B	O.K.		1.750	1.746		.437 ±003	.438
3/8 DEEP	3/8"		1.656	1.655		1/2"	1/2
.172 $\pm^{005}_{001}$	.172		.898 ±003	.8995		.118	.118
.047 DEEP	.048		.437	.4377	2[illegible]	.437	.437
3.562 DIA BSC	3.562		.562 ±003	.5615	—		
9/16	9/16		3/8	3/8	—		
.187	.1835		.562 ±003	.5622	—		
.500	.5002		.375 ±003	.375	—		
.156	.154		5/16	5/16	—		

INSP. BY G.B. (Cordax) DATE 4/25/67

CORP   RECORD OF ACTUALS   B/P SHEET 2

PAGE 3

NO. 1839081   REV 5   S/N   MO NO.

B/P DIM	ACTUAL	B/P NO.	B/P DIM	ACTUAL	B/P NO.	B/P DIM	ACTUAL
4-48 UNF 3B	O.K.	256	1.000 ± 003	.9992	271	4-48 UNF 3B	O.K.
.120 +004/-001 C'BORE	.120	257	6-40 UNF 3B	O.K.	272	3/8 DEEP	3/8"
.047 DEEP	.047	258	7/16 DEEP	7/16"	273	4-48 UNF 3B	O.K.
4-48 UNF 3B	O.K.	259	.147 +005/-001	.147	274	1/4 DEEP	1/4"
3/8 DEEP	3/8"	260	.047 DEEP	.048	275	.406	.4035
1	1 1/8	261	1.750 DIA BSC	1.750	276	.140	.1365
1 3/8	1 3/8	262	3-56 UNF 3B	O.K.	277	2.050	2.0527
3-56 UNF 3B	O.K.	263	3/8 DEEP	3/8	278	1/2	.500
5/16 DEEP	5/16"	264	.106 +004/-001 C'BORE	.106	279	1.187	1.188
1.000	.9985	265	.047 DEEP	.047	280	15/16	.933
1.250	1.251	266	1.485	1.4817	281	3/16	3/16
3.187	3.184	267	.240	.2415	282	.500	.500
1.835	1.8317	268	.400 ± 003	.4005	283	2.375	2.3755
1.250	1.247	269	.800 ± 003	.800	284	.375	.378
1.330	1.333	270	.240	.2395	285	.750	.7506
4-48 UNF 3B	O.K.	251	.500 ± 003	.5017	286	.650 + 005	.656
1/4 DEEP	1/4"	2	1.000 ± 003	1.000	287	.400	.3987
.312	.3127	2	1.250	1.247	288	1.625	1.624
3/16	3/16	2	.406	.4052	289	2.812	2.815
.750	.7487	2	.188	.191	290	1.500	1.4972
.719	.719	2	.187 + 005 DIA	.188	2	.437	.437
1/2	1/2	2	1.125 DEEP	1.130	2	.750	.7492
4-48 UNF 3B	O.K.	2	4-48 UNF 3B	O.K.	2	.750	.750
3/8 DEEP	3/8"	2	3/8 DEEP	3/8"	2	.650 + 005	.652
6-40 UNF 3B	O.K.	2	.656	.652	2	.400	.400
3/8 DEEP	3/8"	2	.312	.310	2	.375 + 005	.379
.156	.156	2	.656	.658	2	.425	.421
2.188	2.183	2	.500	.5012	2	.850	.846
1.688	1.6885	2	8-36 UNF 3B	O.K.	2	8-36 UNF 3B	O.K.
.1875	.8767	2	3/8 DEEP	3/8"	3	3/8 DEEP	3/8"
2.188	2.1877	2	.172 +005/-001	.172	—		
1.250	1.246	2	.047 DEEP	.046	—		
.400 ± 003	.401	2	3.560 DIA. BSC.	3.560	—		
.800 ± 003	.799	2	3.094	3.094	—		
.500 ± 003	.4995	2	.437	.4365	—		

INSP BY G.B. (cordax)   DATE 4/26/17

CORP. RECORD OF ACTUALS B/P SHEET 2.

PAGE 4

PART NO. 1839081 REV S S/N JOB NO.

	B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL
30	$.172^{+.005}_{-.001}$	.172	36			71		
3	.047 DEEP	.047	37			72		
30	3.562 DIA BSC	3.562	38			73		
3	6-40 UNF 3B	O.K.	39			74		
30	3/8 DEEP	3/8"	40			75		
3	8-36 UNF 3B	O.K.	41			76		
30	3/8	3/8"	42			77		
3	.812	.8087	43			78		
30	.500	.5000	44			79		
3	19/32	19/32	45			80		
3	.750	.7505	46			81		
3	1/2	.497	47			82		
3	.406 DEEP	.500	48			83		
3	1/4-28 UNF 2B	O.K.	49			84		
3	1/4	1/4	50			85		
3	.688	.6855	51			86		
3	4.094	4.0905	52			87		
3	.594	.5945	53			88		
3	688	.6890	54			89		
3	.156	.1545	55			90		
3	⊕ T .003	.003	56			91		
3	⊕ S .003 DIA	.0015	57			92		
3	⊕ R .003 DIA	.0015	58			93		
3	⊕ V .003 DIA	.0025	59			94		
3	⊕ F .003 DIA	.003	60			95		
3	⊕ W .003 DIA	.0015	61			96		
3	1 1/8	1.130	62			97		
3	1 1/8 DEEP	1 1/8	63			98		
3	6-40 UNF 3B	O.K.	64			99		
3	3/8 DEEP	3/8"	65			100		
3	1.188 DIA BSC	1.188	66			101		
3	⊕ AA .003 DIA	.003	67			102		
3	30° BASIC	30°	68			103		
3	10° BASIC	10°	69			104		
3	.047 DEEP	.048	70			105		

INSP. BY G.B. (Condor) DATE 4/25/67

[illegible] CORP

RECORD OF ACTUALS

B/P SHEET 3

PAGE 1

PART NO. 1839081 REV. 5 S/N P.O. NO.

B/P LOC.	B/P DIM.	ACTUAL	B/P LOC.	B/P DIM.	ACTUAL	B/P LOC.	B/P DIM.	ACTUAL
1	⊥Z .0002		36	.125	.1235	71	1.075	1.076
2	⊙F .002 TIR		37	1.000	1.002	72	1°30' ± 15'	1°30"
3	3.3750+0002	3.375025-50	38	.015 R	.015	73	1/16	N.A.
4	2 3/8	2 3/8	39	3.7500 ± 001	3.7505	74	8-36 UNF 3B	O.K.
5	16✓	O.K.	40	7.500 ± 001	7.5004	75	3/8 DEEP	3/8"
6	11K .002	.002	41	1/16 R All Around BOTH SIDES	1/16" R	76	.172 +.005 -.001 CB.	.172
7	11K .002	.002	42	⌒ .0001	.0003	77	.047 DEEP	.048
8	2.922-.005	2.917	43	11X .001	.00015	78	3.562 DIA BSC.	3.562
9	2.859	2.854	44	32✓	O.K.	79	1/8	.130
10	.140	.138	45	3/32	.094	80	1/16 R TYP	1/16"
11	.140	.140	46	.015 X 45°	.015 X 45°	81	29/32	29/32
12	1/16 R	1/16	47	.015 R	.015	82	1/4	.249
13	.125	.125	48	1.000 +.008 -.002 DIA.	OUT OF RD. T.I.R. .0020 1.008	83	1.500 R	1.505
14	1/32 R	1/32	49	.187+005 DIA	.187	84	1.950 R	1.955
15	8.125	8.129	50	.375 DIA.	.375	85	1.000 R	1.000
16	5.781	5.785	51	4.062	4.063	86	1.125 R	1.125
17	1.297+005	1.2995	52	.270	N.A.	87	.938 R	.938
18	.960+005	.9635	53	.250 +.005 -.001	.252	88	1.000	1.005
19	.750	.750	54	3" DIA.	3.015	89	52°	52°
20	1.250	1.252	55	1.969 R	1.970	90	1/2"	1/2"
21	1/8 R	1/8	56	3°	3°	91	3/8" TYP	3/8"
22	1.375	1.373	57	27°	27°	92	3/4 TYP	3/4"
23	.875	.866	58	27°	27°	93	.969 R	.969
24	1/8 R APPROX All Around	1/8"	59	1.950 R TYP	1.955	94	1.937 R	1.938
25	1/16 X 45°	1/16" X 45°	60	1/16 R APPROX.	1/16"	95	1.125	1.125
26	3.7500+.0002	3.75010/3.7501	61	3/8 R	3/8"	96	1 5/8	1 5/8"
27	2.375 DIA	2.386	62	1/2	1/2"	97	7/16	7/16"
28	1.500 DIA	1.503	63	1 11/32	1 11/32"	98	3/4	3/4"
29	⊥X .0002		64	1.937	1.940	99	3/8	3/8"
30	16✓	O.K.	65	30°	30°	100	1.188	1.190
31	.015 X 45°	.015 X 45°	66	10°	10°	101		
32	2°25' ± 15'	2°-25'	67	1.969	1.970	102		
33	32✓	O.K	68	3/4	3/4"	103		
34	⌒ .0001		69	3/8	3/8"	104		
35	11J .002	.001	70	1/4 R TYP	1/4"	105		

INSP BY [illegible signature] DATE

[illegible] CORP. RECORD OF ACTUALS B/P SHEET 3

PAGE 2

NO. 1839081 REV. 5 S/N ____ P.O. NO. ____

B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL
.969 R	.969	136	1.125 DIA THRU	1.1295	171	.187+.005	.187
55°	55°	137	.750 DIA	.755	172	.284+.001	.284
45°	45°	138	.284+.001 DIA	.284	173	32√	O.K.
60°	60°	139	.208	N.A.	174	.010 R	.010
40°	40°	140	1/16	N.A.	175	45°	45°
43°	43°	141	.187+.005 DIA	.187	176	.030	.030
1.937 R TYP	1.937	142	1.812 DEEP	1.815	177	1.266	1.272
3/8 TYP	3/8"	143	3.141-.005	3.1375	178	1.141	1.141
3/4 TYP	3/4"	144	2.859+.010	2.872	179	.641	.653
1.187	1.187	145	2.703+.010	2.713	180	.266	.264
.750 R	.750	146	2 9/32	2 9/32"	181	3.300+.002 DIA	3.303
32√	O.K.	147	15/16	15/16"	182	3.188 DIA.	3.192
30° INCL	30°	148	3.312 DIA	3.320	183	1.800±.001	1.8085
.312+.005	.312	149	5/16	5/16"	184	3.312 DIA	3.326
1/4	.251	150	1/4 TYP	1/4"	185	32√	O.K.
.284+.001 DIA	.284	151	1/8 TYP	1/8"	186	32√	O.K.
.312+.005 DIA	.313	152	.281 R TYP	.281	187	.750 DIA	.755
30° INCL.	30°	153	1/32 R UNDERCUT	1/32"	188	.312+.005	.312
.187+.005 DIA	.187	154	.040	.040	189	.284+.001	.284
32√	O.K.	155	5/16	5/16"	190	30° INCL.	30°
1.800±.001	1.8001	156	5/16	5/16"	191	2.703+.010	2.708
32√	O.K.	157	.281 R TYP	.281	192	2.859+.010	2.861
3.188	3.200	158	7/16	7/16"	193	3.141+.010	2.345
.266	.262	159	7/32	7/32"	194	1/8	.130
.641	.637	160	1/8 TYP	1/8"	195	1/16 R TYP	1/16"
1 11/32	1 11/32"	161	1/4 TYP	1/4"	196	1.266	1.274
1.266	1.271	162	1/8	1/8"	197	.172	.174
2.875	2.880	163	7/16	7/16"	198	.284+.001 DIA	.185
1 3/16	1 3/16"	164	7/32	7/32"	199	.312+.005	.312
1/8	.116	165	.187+.005 DIA	.187	200	30° INCL	30°
3/16	3/16"	166	2 1/16	2 1/16"			
1/16 R TYP	1/16"	167	1/2	.485			
17/32	17/32"	168	30° INCL.	30°			
1/16 R	1/16"	169	.312+.005	.312			
1/16 R	1/16"	170	32√	O.K.			

INSP BY [signature] DATE ____

CORP

RECORD OF ACTUALS

B/P SHEET 3.
PAGE 3

PART NO. 1839081 REV. S S/N ______ P.O. NO. ______

	B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL	B/P LOC.	B/P DIM	ACTUAL
20	32✓	O.K.	236	1.375	1-378	71		
2	32✓	O.K.	237	3/16 R TYP	3/16	72		
20	1/32-1/64 R	1/32"	238	.344	.349	73		
2	3.188 DIA.	3.198	239	1.000	1.001	74		
20	3.300+002 DIA	3.302	240	2.344	2.349	75		
2	2.730	2.730	241	1/4	.234	76		
20	9°38' ± 15'	9°38"	242	2.094	2.099	77		
2	3.531	3.531	243	1/2"	.484	78		
20	.208	N.A.	244	3.432+005	3.4335	79		
	.750	.755	245	3° ± 15'	3°	80		
	.284+001 DIA	.284	246	1/16	N.A.	81		
	32✓	O.K.	247	.270	N.A.	82		
	1/16	N.A.	248	.250+005 DIA	.252	83		
	3° ± 15'	3°	249	.187+005 DIA	.187	84		
	3.234	2.234	250	1.000	1.000	85		
	.187+005 DIA.	.187	251	2.594	2.5973	86		
	3.141+005	3.145	252	1/8 R	1/8	87		
	2.859+010	2.875	253	1/8	.124	88		
	2.703+010	2.714	254	1/16	N.A.	89		
	30° INCL.	30°	255	⊕ H .003 DIA		90		
	32✓	O.K.	256	1.390 DIA.	1.392	91		
	.312+005	.312	257	2.250 DIA	2.251	92		
	3.312	3.3235	58			93		
	.187+005 DIA	.187	59			94		
	3.375	3.375	60			95		
	.208	N.A.	61			96		
	1/16	N.A	62			97		
	.208	N.A.	63			98		
	.187+005 DIA (REF)		64			99		
	4-48 UNF 3B	O.K.	65			100		
	3/8 DEEP	3/8"	66			101		
	.437	.437	67			102		
	.062	.062	68			103		
	1.125	1.123	69			104		
	.250	.253	70			105		

INSP BY [signature] DATE ______

94.1 Grams

SHEET NO. 2

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

DATE 3-15-67

INSPECTOR 20 V APPROVED BY CBL

PART NAME Sleeve
PRINT NUMBER 1837870 REVISION R
A.B.C. JOB NUMBER 20-1095
CUSTOMER Battelle Memorial Institute
PURCHASE ORDER NUMBER S-6370
QUANTITY 1 piece LOT NO. #1

SERIAL / DIMENSION	NO. / TOL.		V-4								
.104	+.004 -.001		.104								1
1/8 R typ			1/8								2
.6250	+.0000 -.0002		.62494							20 V	3
.210	±.005		.2115								4
1.156	±.005		1.156								5
.869	±.005		.869								6
40°0'	±15'		40°								7
20°0'	±15'		20°								8
(4) 2-64 UNF 3B			OK								9
(4) 1-72 UNF 3B			OK								10
⊕ .003 dia			OK								11
.750	±.005		[illegible]								12
.375	±.005		.374								13
.62[illegible]	±.001		.6225								14
⊙ A.0[illegible] TIR			OK								15
⊥ C.0[illegible]			OK								16
.500[illegible]	+.0000 -.0002		.49994							20 V	17
⊥ C.0001			OK							20 V	18
B/			OK							20 V	19
.4375	+.0000 -.0002		.43744							20 V	20
⊙ A.0002			OK							20 V	21
.113	+.003 -.000		.113								22
.438	+.003 -.000		.439								23
.186	+.000 -.002		.1855								24
.419	±.001		.4198								25
(12) 2-64 UNF 3B			OK								26
⊕ C.003 dia			OK								27

SHEET NO. 74

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

	SERIAL DIMENSION	NO. TOL.				
Left center view	1.100	±.003		1.0995		28
	1.100	±.003		1.0995		29
	.080	+.004 -.001		OK.		30
(4)	.020 R	±.005		OK.		31
	8✓			OK.		32
	⊥ C .0001			OK.		33
	.025	±.003		OK		34 X
	.6240	+.0000 -.0002		.6394	20 V	35 X
	8✓			OK.		36
	⊥ C .0001			OK		37
	⊙ .00005 T.I.R.			.000004		38
	1.4234	+.0001 -.0000		[illegible]	20/20	39 X
	// E .000025			.000020	20 V	40
	⌒ .000035			.000020	20 V	41
center view	/ C .000035			.000035	20 V	42
	⊙ B .001 T.I.R.			⊙ .001 max		43
	.375	±.002		.374		44 X
	.104	+.004 -.001		.105		45
	.010 R max			.006		46
	.500	±.002		.501		47
	⊥ B .0002			.0002 max		48
	⌒ .0001			⌒ .0001 [illegible]		49
	2.682	±.001	2.6825			50
	⊥ B .0002			⊥ B [illegible]		51
	16✓			10✓		52
	1.42232	+.0001 -.0000		1.4[illegible]	20 V	53 X
	1.448	±.001		1.448		54
	.010 R max			.006		55
	31/64-56-NS-3A			OK.		56
	.1875	+.0002 -.0000		.1876	20 V	57 /
	⊙ A .0002 T.I.R.			⊙ A .0002		58
	.156	±.005		.156		59
	1.053	±.005		1.050	V	60 X
	⊥ A .0001			with .0001	2 V	61

SHEET NO 3/4

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

SERIAL DIMENSION	NO. TOL.										
⌒.00005			W/IN .00005								62
.010 R	max		W/IN .010 R max								63
(2) .010 x 45°	+.000 -.004		.005 x	45°							64
2.188	±.001		2.188								65
1.838 typ	±.005		1.840								66
1.638 typ	±.005		1.639								67
1.066	±.005		1.055								68
.750	±.005		.7495								69
.010 R	±.005		.006								70
.050 typ	±.005		.049								71
(2) .020 R	±.005		ok								72 X
.015 x 45°	±.005		.015 x	45°							73
⊥C.000035			[illegible]								74
⌒.000025			[illegible]								75
(36) .040	+.003 -.001		.040								76
⊕C.003 dia			⊕C W/IN .003								77
1.046	±.002		1.0945-	1.0975							78
.812 typ	±.002		.812								79
(36) .0225	±.001		ok								80 X
○.0002			ok								81
⊕.002 dia			ok								82
30°			30°								83
16√			16√								84
.005	+.002 -.000		.006								85
.001-.003	P.P.		ok								83
.0003 R	+.0002 -.0000		.0004								84
30°			30°								85
.005	+.000 -.002		.003								86
.005 max	x 45°		.005 x 45°								87
.250 typ	+.005 -.000		.257								88
⊙D.0005	TIR		⊙D W/IN .0005								89
(6) 1-72-UNF	3B		Go"-No Go"								90
⊕B.003 dia			.003 [illegible]								91
.250	±.005		.250								92

SHEET NO. 4/4

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

SERIAL DIMENSION	NO. TOL.												
.750	±.005		.750										93
.0323	+.0000 -.0005		OK.										94
.125 dp & Press			.125 dp										20 V 95
.750	±.005		.750										96
.375	±.005		.375										97
.005 max			.003										98
.750	±.005		.750										99
.375	±.005		.376										100
Notes	1		ok.										
	2		ok.										
	3		ok.										
	4		ok										
	5		ok										
	6		ok										
	7		ok.										
	8		ok										
	9		ok										
	10		ok.										
	11		ok										
	12		ok										
	13		ok										
	14		ok										
	15		ok										

94. Grams

American Beryllium Company Inc.

SHEE

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

DATE 4-24-67

INSPECTOR (6 V) (V) (16 V) APPROVED BY [illegible]

PART NAME Sleeve

PRINT NUMBER 1837870 REVISION R

A.B.C. JOB NUMBER 20-1095

CUSTOMER Battelle Memorial Institute

PURCHASE ORDER NUMBER S-6370

QUANTITY 2 pcs LOT NO. 1-A

SERIAL	NO.			#2	#3						
DIMENSION	TOL.										
.104	+.004 -.001			"Go" - "No Go"						V	1
1/8 R typ				1/8 R typ							2
Left Center View .6250	+.0000 -.0002			.6249	.62500						3
.210	±.005			.216	.215						4
1.156	±.005			1.152	1.153						5
.869	±.005			.870	.869						6
40°0'	±15'			40°							7
20°0'	±15'			20°							8
(4) 2-64 UNF 3B				"Go" - "No Go"							9
(4) 1-72 UNF 3B				"Go" - "No Go"							10
⊕ .003 dia				⊕ .002 dia max							11
.750	±.005			.750	.750						12
.375	±.005			.375	.375						13
.622	±.001			.6225	.6225						14
⊙ A .00005 TIR				.00003	.00001						15
⊥ C .0001				⊥ C .0001 max							16
.5000	+.0000 -.0002			.4999	.4999					(6 V)	17
⊥ C .0001				⊥ C .0001 max							18
8/				8/ max							19
.4375	+.0000 -.0002			.43736	.4374					(V)	20
⊙ A .0002				.00005	.00005						21
.113	+.002 -.000			.1135	.1145						22
.438	+.003 -.000			.4382	.4385						23
.186	+.000 -.002			.186	.186						24
.419	±.001			.419	.420						25
(2) 2.64 UNF 3B				"Go" - "No Go"							26
⊕ C .003 dia				⊕ C .003 dia max						V	27

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

Left Center View

SERIAL DIMENSION	NO. TOL.			#2	#3							
1.100	±.002			1.100	1.100							28
1.100	±.002			1.100	1.100							29
.080	+.004 -.001			"Go" -	"No Go"							30
(4) .020R	±.005			.020R								31
8/				8/ max								32
⊥C .0001				⊥C .0001 max								33
.025	±.003			.0269	.0259							34
.6240	+.0000 -.0002			.62222	.623880							35
8/				8/ max								36
⊥C .0001				⊥C .0001								37
⊙ .00005	TIR			.00003	.00003							38
1.4234	+.0001 -.0000			1.4234	1.4234							39
// E .000025				.000010	.000010							40
⌒ .000025				.000010	.000010							41
⊥C .000025				.00002	.00002							42
⊙B .001 TIR				⊙B .001 max								43
.375	±.002			.374	.374							44
.104	+.004 -.001			"Go" -	"No Go"							45
.010R max				.010 R max								46
.500	±.002			.499	.498							47
⊥B .0002				⊥B .0002 max								48
⌒ .0001				⌒ .0001 max								49
2.682	±.001			2.683	2.683							50
⊥B .0002				⊥B .0002 max								51
16/				16/ max								52
1.4232	+.0001 -.0000			1.42320	1.4233							53
1.448	±.001			1.4474	1.4477							54
.010R max				.010	.010							55
31/64-56-NS-3A				OK	OK							56
.1875	+.0002 -.0000			.1875	.1875							57
⊙A .0002 TIR				⊙A .0002 max								58
.156	±.005			"Go" -	"No Go"							59
1.053	±.005			1.057	1.058							60
⊥A .0001				.0001 max								61

Center View

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

	SERIAL DIMENSION	NO. TOL.			#2	#3						
Center View	⌒.00005				.00005	max						62
	.010 R				.010	R max						63
(2)	.010 x 45°	+.000 -.004			.006	x 45°						64
	2.188	±.001			2.1883	2.1885						65
	1.838 typ	±.005			1.841	typ						66
	1.638 typ	±.005			1.627	typ						67
	1.066	±.005			1.055	1.056						68
	.750	±.005			.747	.748						69
	.010 R	±.005			.010	R max	/					70
	.050 typ	±.005			.050	typ						71
(2)	.020 R	±.005			.020	Brk						72
	.015 x 45°	±.005			.018x45°	.018x45°						73
	⊥C.000035				.00002	.00002						74
	⌒.000035				.00001	.00001						75
(36)	.040	+.003 -.001			"Go"-"No Go"							76
Right Center View	⊕C.003 dia				⊕C.002 dia max							77
	1.046	±.002			1.047	typ						78
	.812 typ	±.002			.812	typ						79
(36)	.0225	±.001			.0220	[illegible]						80
	O.0002				O.000[illegible]	max						81
	⊕.002 dia				⊕.002 dia max							82
Detail D	30°				30°							83
	16				16 max							84
	.005	+.002 -.000			.006	typ						85
Detail B	.001-.002	B.B.			OK							83
	.0003 R	+.0002 -.0000			OK	OK						84
	30°				30°							85
	.005	+.000 -.002			.004	typ						86
	.005 max x	x 45°			.005 x	45°						87
	.250 typ	+.005 -.000			"Go"-"No Go"							88
	⊙D.0005	TIR			⊙D.0005 max							89
(6)	1-72-UNF	3B			"Go"-"No Go"							90
View C.C.	⊕B.002 dia				⊕B.002 max							91
	.250	±.005			.250	.250						92

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

SERIAL DIMENSION	NO. TOL.			#2	3						
.750	±.005			.750	.750						93
.0323	+.0000 -.0005			.0323	.0323						94
.125 dp & Press				ok	ok						95
.750	±.005			.748	.748						96
.375	±.005			.374	.374						97
.005 max				OK	OK						98
.750	±.005			.751	.751						99
.375	±.005			.375	.375						100
Notes	1	ok.									
	2	ok.									
	3	ok									
	4	ok.									
	5	ok									
	6	ok.									
	7	ok.									
	8	ok									
	9	ok									
	10	ok									
	11	ok									
	12	ok									
	13	ok.									
	14	ok.									
	15	ok.									

AMERICAN BERYLLIUM COMPANY, INC.
MANUFACTURERS OF ULTRA PRECISION MACHINED PARTS
P. O. BOX 1479 • U. S. HIGHWAY 301 AT TALLEVAST ROAD • SARASOTA, FLORIDA 33578

To: BATTELLE MEMORIAL INSTITUTE
505 KING AVE.
COLUMBUS, OHIO

Date 4-27-67

Purchase Order No S 6370

Part No X1837870/R

Packing Slip No 32137

Quantity 2

Cert. A [XX] We certify that, to the best of our knowledge, the articles conform to your drawing and purchase order requirements.

Cert. B [ ] We certify that materials used on this order meet specification requirements and that the physical and/or chemical test reports are on file subject to examination.

Cert. C [XX] We certify that materials used were only those supplied by BATTELLE MEMORIAL INSTITUTE specifically for this order.

Cert. D [ ] We certify that the above described parts have been processed in conformance to the required specifications as listed below.

Gov't. MIL or your Spec. No.	Name and Address of Processing Firm	Gov't. Cert. Approval No.	Approval Date

AMERICAN BERYLLIUM COMPANY, INC.

F. W. Schrader, Quality Control Mgr.

APPENDIX C

DIMENSIONAL CERTIFICATION OF ACCELEROMETER SLEEVES

AMERICAN BERYLLIUM COMPANY, INC.
MANUFACTURERS OF ULTRA PRECISION MACHINED PARTS
P. O. BOX 1479 • U. S. HIGHWAY 301 AT TALLEVAST ROAD • SARASOTA, FLORIDA 33578

To: BATTELLE MEMORIAL INSTITUTE
505 KING AVENUE
COLUMBUS, OHIO 43201

Date JANUARY 9, 1967

Purchase Order No S-6370

Part No X1801776/M

Packing Slip No 31569

Quantity 2

Cert. A [X] We certify that, to the best of our knowledge, the articles conform to your drawing and purchase order requirements.

Cert. B [ ] We certify that materials used on this order meet specification requirements and that the physical and/or chemical test reports are on file subject to examination.

Cert. C [X] We certify that materials used were only those supplied by BATTELLE MEMORIAL INSTITUTE specifically for this order.

Cert. D [ ] We certify that the above described parts have been processed in conformance to the required specifications as listed below.

Gov't. MIL or your Spec. No.	Name and Address of Processing Firm	Gov't. Cert. Approval No.	Approval Date

AMERICAN BERYLLIUM COMPANY, INC.

F. W. Schrader, Quality Control Mgr.

206.Gr

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

DATE 12-22-66

INSPECTOR ______ (16 V) APPROVED BY ______

PART NAME Sleeve - Air Bearing

PRINT NUMBER X1801776 REVISION 17

A.B.C. JOB NUMBER 20-1092

CUSTOMER Battelle Memorial Inst

PURCHASE ORDER NUMBER S-6370

QUANTITY 2 pcs LOT NO. 1

	SERIAL / DIMENSION	NO. / TOL.			V-1	V-2						
												1
	.342	±.002			.342	.342						2
Left view	.171	±.002			.171	.171						3
	1/8 R	±1/64			1/8	1/8						4
	3/8	±1/64			3/8 typ.							5
	3/4 typ.	±1/64		.780 -	.782 all fins							6
	1.260	±.002			1.260	1.260						7
	1/8 R typ.				1/8 R	1/8 R						8
(24)	.041	+.004 -.001			All "Go" Refuse "No Go"							9
	⊙ A .002				⊙ A .002 max							10
	3.289	±.003			3.289	3.289						11
	⊙ A .002 TIR				.0002	max						12
(6)	2-64 UNF-3B			All "Go" - Refuse "No Go"								13
	4 data					OK						14
(4)	2-64-UNF-3B			All "Go" - Refuse "No Go"								15
	1/16 R	±1/64			1/16	1/16						16
	.001 step				No	Step.						17
Upper center view	.156	±.002			.156	.156						18
	.156	±.002			.156	.156						19
(2)	.125	±.005		All "Go" - Refuse "No Go"								20
	Serial No.			All Pcs OK								21
(4)	2-64-UNF-3B			All "Go" - Refuse "No Go"								
	4 data				OK							22
	.686	±.005			.687	.685						23
Center view	2.16330	±.00015			2.16330	2.16328						24
	4 ✓				4 ✓	4 ✓						25
	Note 11				OK	OK						26
	2.990	±.005			2.983	2.989						27

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

	SERIAL DIMENSION	NO. TOL.			V-1	V-2						
	.194	±.001			.194	.194						61
	.250	±.005			.250	.250						62
(3) Right	.171	+.005 -.001		All "Go" - Refuse "No Go"								63
center view	+ data				OK.							64
	1/4 R	± 1/64			1/4"	1/4"						65
	3.052	±.005			3.052	3.052						66
	3.822	±.005			3.826	3.825						67
	1.206 typ	±.005			1.206	typ						68
	1.460 typ	±.005			1.460	typ						69
	15°	±5'			15°							70
(2)	2-64-UNF-3B			All "Go" - Refuse "No Go"								71
	+ data				OK.							72
	1.703	±.002			1.703	1.703						73
(6)	2-64-UNF-3B			All "Go" - Refuse "No Go"								74
	+ data				OK.							75
	1/8 R max typ				1/8"	1/8"						76
	.812	±.005			.815	.815						77
	.406	±.005			.407	.407						78
[illegible]	.070 + data	+.003 -.001			All "Go" - Refuse "No Go"							
	Notes		1	CHECK								
			2	CHECK								
			3	ALL PCS. OK								
			4	ALL PCS. OK								
			5	CHECK								
			6	CHECK								
			7	CHECK								
			8	CHECK								
			9	CHECK								
			10	CHECK								
			11	CHECK								
			12	CHECK								
			13	CHECK								

ABC P

16 V

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

SERIAL DIMENSION	NO. TOL.			V-1	V-2						
.194	+.001 -.001			.194	.194						61
.250	±.005			.250	.250						62
(3) Right .171	+.005 -.001		All "Go" - Refuse "No Go"								63
Center view + data				OK.							64
1/4 R	±1/64			1/4"	1/4"						65
3.052	±.005			3.052	3.052						66
3.822	±.005			3.826	3.825						67
1.206 typ	±.002			1.206	typ						68
1.460 typ	±.002			1.460	typ						69
15°	±5'			15°							70
(2) 2.64-UNF-3B			All "Go" - Refuse "No Go"								71
+ data				OK.							72
1.703	±.002			1.703	1.703						73
(6) 2-64-UNF-3B			All "Go" - Refuse "No Go"								74
+ data				OK.							75
1/8 R max typ				1/8"	1/8"						76
.812	±.005			.815	.815						77
.406	±.005			.407	.407						78
[illegible] .072 + data	+.003 -.001		All "Go" - Refuse "No Go"								
Notes		1	CHECK								
		2	CHECK								
		3	ALL PCS. OK								
		4	ALL PCS. OK								
		5	CHECK								
		6	CHECK								
		7	CHECK								
		8	CHECK								
		9	CHECK								
		10	CHECK								
		11	CHECK								
		12	CHECK								
		13	CHECK								

P

16 V

APPENDIX D

DIMENSIONAL CERTIFICATION OF
INNER CYLINDERS

AMERICAN BERYLLIUM COMPANY, INC.
MANUFACTURERS OF ULTRA PRECISION MACHINED PARTS
P. O. BOX 1479 • U. S. HIGHWAY 301 AT TALLEVAST ROAD • SARASOTA, FLORIDA 33578

To: BATTELLE MEMORIAL INSTITUTE
505 KING AVENUE
COLUMBUS, OHIO 43201

Date 12/27/66

Purchase Order No S-6370 Part No GC 425797/B

Packing Slip No 31521 Quantity 3

Cert. A [XX] We certify that, to the best of our knowledge, the articles conform to your drawing and purchase order requirements.

Cert. B [ ] We certify that materials used on this order meet specification requirements and that the physical and/or chemical test reports are on file subject to examination.

Cert. C [XXX] We certify that materials used were only those supplied by BATTELLE MEMORIAL INSTITUTE specifically for this order.

Cert. D [ ] We certify that the above described parts have been processed in conformance to the required specifications as listed below.

Gov't. MIL or your Spec. No.	Name and Address of Processing Firm	Gov't. Cert. Approval No.	Approval Date

AMERICAN BERYLLIUM COMPANY, INC.

F. W. Schrader, Quality Control Mgr.

vt. 75 g.

SHEET NO. 1

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

DATE 12/20/66

INSPECTOR 17 V 18 V 16 V APPROVED BY [signature]

PART NAME CYLINDER, INNER
PRINT NUMBER GC 425797 REVISION B
A.B.C. JOB NUMBER 20-1094
CUSTOMER BATTELLE MEMORIAL INSTITUTE
PURCHASE ORDER NUMBER 56370
QUANTITY 3 LOT NO. 1

SERIAL	NO.		V-1	V-2	V-3						ITEM
DIMENSION	TOL.										NO.
.250 R. TYP	±.004		.250	.250	.250					17 V	1
26°	±0°30'		26°	26°	26°					17 V	2
26°	±0°30'		26°	26°	26°					17 V	3
1.520 DIA.	±.004		1.521	1.521	1.521					17 V	4
1.986 DIA.	±.001		1.986	1.986	1.986					17 V	5
.020 X 45°			.019	.019	.019	X45°				17 V	6
.9930 SPH.R	±.0005		O.K	TO	SPH	ER,	GAGE			18 V	7
.002 DP. MAX.			.001	.001	.001					18 V	8
⊕ .003			.002	.002	.002					18 V	9
.19	±.01		.195	.195	.195					18 V	10
(4) #4-48 UNF-3B			ALL	PCS	CHK	OK	GAGN-GO			17 V	11
.125	±.004		OK	TO-PINS						17 V	12
.375	±.004		ALL	PCS	CHK	OK	TO-DEPTH			17 V	13
.062	±.004		.060	.060	.060					18 V	14
30°	±1°		30°	30°	30°					17 V	15
.050	±.004		.050	.050	.050					18 V	16
-A- .920 DIA.	+.002		.9215	.9213	.9215					18 V	17
8√			OK	OK	OK						18
.250 DIA.	±.004		.2495	.2495	.2495					18 V	19
.0780 DIA.	+.0005		.0776	.0776	.0776					18 V	20
◎ A .002	T.I.R.		.001	.0005	.001					18 V	21
1.016 DIA.	-.005		1.013	1.012	1.012					18 V	22
.100	±.004		.100	.100	.100					18 V	23
2.507	±.003		2.507	2.507	2.507					18 V	24
16√			16	16	16					18 V	25
⌒ .00001			.000080	.000050	.000050						26
⊥ B .0002			.0001	.0001	.0001						27

SHEET NO. 2

American Beryllium Company Inc.

U. S. HIGHWAY 301 AT TALLEVAST ROAD SARASOTA, FLORIDA

P/N GC 425797

SERIAL DIMENSION	NO. TOL.		V-1	V-2	V-3						
2.110	±.001		2.1108	2.1108	2.1108						28
1.0209	±.0005		1.0206	1.0205	1.0205						29
.945	±.004		.949	.946	.948						30
.320	±.004		.320	.320	.320						31
45°	±1°		45°	45°	45°						32
.020	±.004		.021	.021	.021						33
#6-40UNF-	3B		ALL	PCS	CHK	OK	GO+NO-GO				34
.375 DP.	±.004		ALL	PCS	CHK	OK	TO-DEPTH				35
⊕A .003	DIA.		⊕A	W/IN	.003						36
30° TYP.	±1°		30°	30°	30°						37
30° TYP.	±1°		30°	30°	30°						38
1.805 TYP.	±.004		1.806	1.806	1.806						39
.010 R. TYP.	±.004		.006	.006	.006						40
2.175 DIA.	-.002		2.1740	2.1740	2.1745						41
⊚A .0005	T.I.R.		.0001	.0001	.0001						42
2.0256 DIA	+.0001		2.02563	2.02562	2.02564						43
B- ⊚A .0002	T.I.R.		.0001	.0001	.0001						44
16√			✓	✓	✓						45
2.0250 DIA	+.002		2.0250	2.0250	2.0250						46
⊚A .001	T.I.R.		.0002	.0002	.0002						47
.107	±.004		.107	.107	.107						48
.080	±.004		.080	.080	.080						49
NOTES:	1-		ALL	PCS	OK						
	2-		ALL	PCS	OK						
	3-		ALL	PCS	OK						
	4-		ALL PCS OK								
	5-		ALL	PCS	OK						
	6-		TO BE DONE AT ASSY.								
	7-		ALL	PCS	OK						
	8-		ALL	PCS	OK						
	9-		ALL	PCS	OK						

APPENDIX E

DIMENSIONAL CERTIFICATION OF INNER CYLINDER COVERS

CERTIFICATE OF COMPLIANCE

BARDEN-LEEMATH
DIVISION OF THE BARDEN CORPORATION
45 CROSSWAYS PARK DRIVE • WOODBURY, L. I., NEW YORK 11797 • TWX-510-221-2185 • TEL. 516-921-3080

To: BATELLE MEMORIAL INSTITUE

Gentlemen:

We hereby certify that the material and/or work performed in the quantities as called for in Purchase Order No. S6371

Part Nos. GC425798 Date Shipped 3/31/67

Packing Slip No. 955 are in conformance with the requirements, specifications and drawings listed on the order.

Test reports for this material are on file and are available on request.

Harry Prince
QUALITY CONTROL MANAGER

DATE

BARDEN-LEEMATH

45 CROSSWAYS PARK DRIVE ▲ WOODBURY, L.I., NEW YORK 11797 ▲ TWX-510-221-2185 ▲ TEL. 516-921-3080

February 16, 1967

Battelle Memorial Institute
505 King Avenue
Columbus, Ohio 43201

Attention: Mr. Hugh Haynes

Subject : Battelle Memorial Institute
Purchase Order No. S6371
Inner Cylinder Cover
Pt. No. 425798

Dear Hugh,

The enclosed drawing has certain dimensional characteristics numerically identified to conform to our Quality Control Master Drawing. This identification will help isolate discrepancies on two of the three parts we are manufacturing for the Subject Order.

We submit the following data for your evaluation, and hopefully, your approval:

Piece No. 1
Characteristic #20 .172 dim. is .165 to .169
21 .344 typical is .350
47 .151 +.0005 is .152 - .1508
66 .095 +.002 is .096 - .098

Piece No. 2
Characteristic # 2 .010 is .0059 - .0167
41 .635 ±001 is .635 to .638
43 1.270 ±001 is 1.274
75 .1125 ±0005 is .1120 to .1133

Considering the experimental nature of this order we are hopeful these discrepancies may be acceptable.

We await your early disposition.

Regards,

BARDEN-LEEMATH
DIVISION OF THE BARDEN CORPORATION

John Gorman
Sales Manager

JG:hf
Encl.